Introduction of a new rotary-shear frictional testing machine and a result of experiments at intermediate-slip rate range

Atsushi Tsujimoto[1]; Nao Hayashi[2]; Akito Tsutsumi[3]

[1] Geology & Mineralogy, Kyoto Univ.; [2] Department of Geology & Mineralogy, Kyoto Univ.; [3] Graduate School of Science, Kyoto University

Knowledge of the frictional properties of rocks over wide range of slip rate is relevant to understand the faulting processes during a cycle of seismic fault motion. However, due to the limitations of the capacity of the previously developed friction testing machines, it was not able to get good data for rock friction within slip-rate range from ˜0.1 mm/s to ˜10 mm/s. Recently we have developed a new frictional testing machine in order to perform friction experiments within these intermediate slip rate ranges. In this presentation, we introduce this testing machine's outline and a preliminary result for the friction tests performed on gabbro.

The newly developed frictional testing machine is a rotary-shear type friction testing machine. It is equipped with a 5kw AC servo-motor. This motor can produce rotation of ˜30 to 3000 r.p.m and the rotation speed can be changed almost instantaneously by a servo-driver system. Rotation of the motor is introduced to a gear trains system to reduce the initial rotation speed of the motor. This gear-train system reduces the rotation speed of the motor down to 1/10, 1/100 and to 1/1000 with the use of electromagnetic clutch system, which allows us to change the reduction rate of the rotation almost instantaneously. For a hollow-cylindrically shaped specimen with inner and outer diameters of 25 and 40 mm, respectively, slip rates that can be produced with this machine is in the range from ˜0.05 mm/s to ˜5m/s. Normal load is applied through the vertically oriented loading column by the use of a 10 KN air-driven actuator.

Experiments were performed with this testing machine at slip rate from 0.035 mm/s to 35 mm/s in order to examine velocity dependence of steady-state sliding friction. In the experiments, we used a pair of hollow-cylindrical specimens of gabbro, of which inner and external diameters are 25 mm and 40 mm, respectively. According to the experiments performed at low normal stress of about 1 MPa, it is suggested that there is the range of slip rate where friction exhibits slightly positive velocity dependence within the slip rate range slightly lower than 100 mm/s.